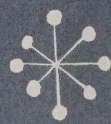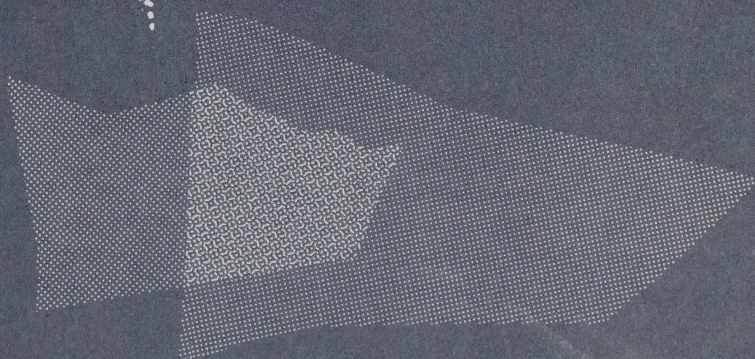Canada. Agriculture Dept. of.
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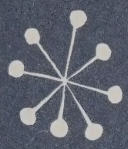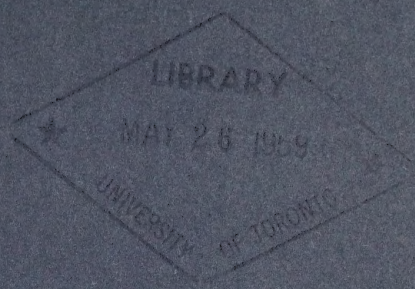
FREEZING
TEMPERATURE
PROBABILITIES
at Ottawa

Geo. W. Robertson
R. M. Holmes

Experimental Farms Service
CANADA DEPARTMENT OF AGRICULTURE
Ottawa, Ontario

FREEZING TEMPERATURE PROBABILITIES

AT OTTAWA

Geo. W. Robertson[1] and R. M. Holmes[2]

Most tables of first and last frosts are based on a temperature of 32 degrees F, the temperature at which water freezes. A temperature of 28 degrees F or lower has often been suggested as a killing frost. However, no one figure can be designated as the temperature at which plants may be damaged. Frost damage depends upon the hardiness of the plant. This hardiness varies with different plants and with the stage of development of the plant. For example, tobacco is damaged by lighter freezes than is wheat; and wheat is more readily injured at the milk stage than at the hard dough stage.

Because of the importance of the different degrees of severity of a freeze, the accompanying tables were prepared to give a detailed picture of the risk and degree of freezing temperatures in the spring and fall at Ottawa. These tables are based on records of minimum temperatures taken at the Central Experimental Farm at Ottawa during the 33-year period 1924 to 1956, inclusive. Temperatures were measured by a minimum thermometer exposed in a standard meteorological shelter at 4.5 feet above ground.

Ground Frost

Ground frost, as indicated by grass minimum temperatures, frequently occurs when the standard minimum temperature is several degrees above the freezing point. Minimum temperatures measured at the tips of grass two inches high may average 6 to 8 degrees lower than the standard minimum. On clear, calm nights when the air is relatively dry the grass minimum may be as much as 10 to 12 degrees colder than the standard minimum. Ground frost may thus occur when the standard minimum temperature is above freezing. The following tables show the probability of the occurrence of the last minimum temperatures in the spring and the first minimum temperatures in the fall between 32 degrees F and 40 degrees F. These temperatures may be accompanied by ground frosts.

There is little or no difference between the grass minimum temperatures and the standard minimum temperatures when a strong wind is blowing or when the sky is overcast.

Spring Freezes

Table 1 shows the percentage probability or number of chances in 100 that

TABLE I – SPRING PROBABILITY OF FREEZING TEMPERATURES AT OTTAWA.

(Percentage probability – number of times out of 100 – that the last spring temperature of a given value will occur on or after a certain date. Based on data[1] from 1924 to 1956 taken at the Central Experimental Farm.)

		Temperature										
		20°	22°	24°	26°	28°	30°	32°	34°	36°	38°	40°
Earliest[2]		March 11	March 12	March 12	March 24	April 9	April 13	April 23	April 29	May 3	May 11	May 15
	90	March 25	March 26	March 29	April 5	April 12	April 25	May 6	May 8	May 12	May 18	May 21
	85	March 28	March 29	April 1	April 8	April 16	April 28	May 8	May 9	May 15	May 20	May 25
	80	March 30	March 31	April 4	April 10	April 18	April 30	May 9	May 11	May 16	May 22	May 28
	75	March 31	April 2	April 6	April 13	April 20	May 2	May 10	May 12	May 17	May 24	May 31
	70	April 2	April 4	April 8	April 15	April 23	May 4	May 12	May 13	May 19	May 26	June 2
	65	April 3	April 5	April 10	April 17	April 25	May 5	May 13	May 14	May 20	May 27	June 5
Percentage	60	April 5	April 7	April 12	April 19	April 26	May 7	May 14	May 15	May 21	May 28	June 7
	55	April 6	April 8	April 13	April 20	April 28	May 8	May 15	May 16	May 22	May 30	June 9
	50	April 7	April 10	April 15	April 22	April 30	May 10	May 16	May 17	May 23	May 31	June 11
Probability	45	April 8	April 11	April 17	April 23	May 1	May 11	May 17	May 18	May 24	June 1	June 13
	40	April 10	April 13	April 18	April 25	May 3	May 13	May 18	May 19	May 25	June 2	June 15
	35	April 11	April 14	April 20	April 27	May 5	May 14	May 19	May 20	May 26	June 4	June 17
	30	April 12	April 16	April 22	April 29	May 7	May 16	May 20	May 21	May 27	June 5	June 20
	25	April 14	April 18	April 24	May 1	May 9	May 17	May 21	May 22	May 28	June 7	June 22
	20	April 16	April 20	April 26	May 3	May 11	May 19	May 22	May 23	May 29	June 8	June 25
	15	April 17	April 22	April 28	May 6	May 14	May 21	May 23	May 24	May 31	June 10	June 28
	10	April 20	April 25	May 1	May 10	May 17	May 24	May 25	May 26	June 2	June 13	July 2
Latest[2]		April 23	May 1	May 14	May 25	May 25	May 25	May 27	June 1	June 22	July 3	July 14

[1] Based on daily minimum temperatures taken in an official shelter 4.5 ft. above ground.
[2] Recorded during period 1924-1956 inclusive.

TABLE II – AUTUMN PROBABILITY OF FREEZING TEMPERATURES AT OTTAWA.

(Percentage probability – number of times out of 100 – that the first autumn temperature of a given value will occur on or before a certain date. Based on data[1] from 1924 to 1956 taken at the Central Experimental Farm.)

Temperature

		40°	38°	36°	34°	32°	30°	28°	26°	24°	22°	20°
Earliest[2]		July 16	Aug. 18	Aug. 25	Sept. 6	Sept. 13	Sept. 14	Sept. 20	Sept. 28	Sept. 28	Oct. 7	Oct. 14
	10	Aug. 17	Aug. 26	Sept. 2	Sept. 12	Sept. 16	Sept. 20	Sept. 26	Oct. 2	Oct. 6	Oct. 12	Oct. 20
	15	Aug. 20	Aug. 28	Sept. 4	Sept. 14	Sept. 17	Sept. 22	Sept. 28	Oct. 4	Oct. 9	Oct. 16	Oct. 23
	20	Aug. 22	Aug. 30	Sept. 6	Sept. 15	Sept. 19	Sept. 24	Sept. 30	Oct. 7	Oct. 12	Oct. 19	Oct. 26
	25	Aug. 24	Sept. 1	Sept. 8	Sept. 16	Sept. 20	Sept. 25	Oct. 2	Oct. 8	Oct. 14	Oct. 21	Oct. 28
	30	Aug. 26	Sept. 3	Sept. 9	Sept. 18	Sept. 22	Sept. 26	Oct. 3	Oct. 10	Oct. 16	Oct. 23	Oct. 31
	35	Aug. 28	Sept. 4	Sept. 10	Sept. 19	Sept. 23	Sept. 28	Oct. 4	Oct. 12	Oct. 18	Oct. 25	Nov. 1
Percentage	40	Aug. 30	Sept. 5	Sept. 11	Sept. 20	Sept. 24	Sept. 29	Oct. 6	Oct. 13	Oct. 20	Oct. 27	Nov. 3
	45	Aug. 31	Sept. 6	Sept. 12	Sept. 21	Sept. 25	Sept. 30	Oct. 7	Oct. 15	Oct. 21	Oct. 29	Nov. 5
Probability	50	Sept. 2	Sept. 8	Sept. 13	Sept. 22	**Sept. 26**	Oct. 1	Oct. 8	Oct. 16	Oct. 23	Oct. 31	Nov. 7
	55	Sept. 3	Sept. 9	Sept. 15	Sept. 23	Sept. 27	Oct. 2	Oct. 9	Oct. 17	Oct. 24	Nov. 2	Nov. 9
	60	Sept. 5	Sept. 10	Sept. 16	Sept. 24	Sept. 28	Oct. 3	Oct. 10	Oct. 19	Oct. 26	Nov. 4	Nov. 11
	65	Sept. 6	Sept. 12	Sept. 17	Sept. 25	Sept. 29	Oct. 4	Oct. 11	Oct. 20	Oct. 28	Nov. 5	Nov. 12
	70	Sept. 8	Sept. 13	Sept. 18	Sept. 26	Sept. 30	Oct. 5	Oct. 13	Oct. 22	Oct. 30	Nov. 8	Nov. 14
	75	Sept. 10	Sept. 15	Sept. 20	Sept. 27	Oct. 1	Oct. 6	Oct. 14	Oct. 23	Nov. 1	Nov. 10	Nov. 16
	80	Sept. 12	Sept. 16	Sept. 21	Sept. 28	Oct. 2	Oct. 8	Oct. 16	Oct. 26	Nov. 3	Nov. 12	Nov. 19
	85	Sept. 15	Sept. 18	Sept. 23	Sept. 30	Oct. 4	Oct. 9	Oct. 18	Oct. 28	Nov. 6	Nov. 15	Nov. 22
	90	Sept. 18	Sept. 21	Sept. 25	Oct. 2	Oct. 6	Oct. 11	Oct. 20	Oct. 30	Nov. 9	Nov. 18	Nov. 25
Latest[2]		Oct. 3	Oct. 3	Oct. 9	Oct. 10	Oct. 16	Nov. 14	Nov. 4	Nov. 22	Nov. 22	Dec. 6	Dec. 11

[1] Based on daily minimum temperatures taken in an official shelter 4.5 ft. above ground.
[2] Recorded during period 1924-1956 inclusive.

the last freeze of a given severity in the spring will occur *on or after* a given date. Suppose that very tender plants are to be transplanted and that 32 degrees F is the critical temperature. The column headed 32 degrees F gives May 27 as the latest occurrence of this temperature. Plants would not be subjected to frost damage if they were planted after this date.

If it is desirable to plant earlier to take advantage of higher market prices for an early crop, a gamble on a small risk of a freeze may be taken. The table gives the probability of losing. Suppose a tender crop is planted early enough to emerge on, let us say, May 21. The chance of a 32-degree temperature on or after this date is 25 per cent or one in four. The farmer or market gardener must take the economic factors and the labor problems into account in deciding whether or not to take such a risk.

Generally growth starts at Ottawa about April 18. As late as April 23, however, there is a 100 per cent chance of a 32-degree temperature occurring on or after this date. After April 23 the probability of freezes of greater severity decreases rapidly. The table shows that there is a 70 per cent chance of a 28-degree freeze and a 45 per cent chance of a 26-degree freeze occurring on or after this date. The severest freeze recorded on April 23 during the 33-year period studied was 20 degrees.

Autumn Freezes

Table 2 shows the number of times in 100 cases (the percentage probability) that the first autumn freeze of a given severity will occur *on or before* a given date. It may be desirable to know when certain plants are likely to be subjected to a fall freeze of 28 degrees. The table gives September 20 as the earliest date of a 28-degree temperature. The probability of the first occurrence of a 28-degree temperature on September 28 is 15 per cent. By October 2 the probability has increased to 25 per cent, and by November 4 it is almost certain that a 28-degree temperature will have occurred.

A careful study of the tables will aid in reducing the gamble taken during early spring and late fall not only in planting and harvesting, but in performing other operations that are affected by freezing temperatures. The tables give a complete picture of the risk or probability of freezing temperatures of varying severity on dates from early March through the summer to early December. They should prove much more valuable than the mere statement that the average date of the last spring frost at Ottawa is May 16 or that the average date of the first autumn frost is September 26.